5. (Currently Amended) The precoder according to claim 2, wherein the mapper comprises:

a table identifying the basic constellation of levels and a mapping from the set of levels outside the basic constellation of levels to levels inside the basic constellation of levels.

6. (Currently Amended) The precoder according to claim 1, wherein each of the set of levels outside the basic constellation of levels is mapped onto only one level inside the basic constellation of levels.

7. (Currently Amended) The precoder according to claim 2, wherein the mapper comprises:

a table having a constellation index basic_const, where the basic_const goes from 1-k to k, associated with each of a plurality of levels inside the basic constellation of levels, and having a constellation index positive_const, where the positive_const goes from k+1 to m, associated with a plurality of levels outside the basic constellation of levels, wherein said k is a constant and said m is a multiple of said k.

8. (Currently Amended) The precoder according to claim 7, wherein each of the plurality _index_ of levels outside the basic constellation of levels index are _is_ mapped onto a level inside the basic ^ constellation of levels according to the equation:

index positive_const→positive_const [[-]] _(2*k); while positive _const>m-k; and

index positive_const→positive_const [[-]] _(2*k)-1; while positive _const<=m-k;

wherein→identifies a the mapping function.

9. (Currently Amended) The precoder according to claim 2, wherein the mapper comprises:

a table having a constellation index basic_const, where the basic_const goes from -k to k ~~1 to k~~, associated with each of a plurality of levels inside the basic constellation of levels, and having a constellation index negative_const, where the negative_const goes from -k-1 to-m, associated with a plurality of levels outside the basic constellation of levels.

10. (Currently Amended) The precoder according to claim 9, wherein each $_\wedge^{index}$ of the plurality of levels outside the basic constellation of levels ~~index are~~ $_\wedge^{is}$ mapped onto a level inside the basic constellation of levels according to the equation:

index negative_const→negative_const + (2*k); while negative_const<-(m-k); and

index negative_const→negative_const + (2*k)+1; while negative_const>=-(m-k);

wherein→ identifies a ~~the~~ mapping function.

11. (Original) The precoder according to claim 7, wherein the mapper further comprises a comparator for comparing the partial result with the levels in the table.

12. (Original) The precoder according to claim 11, wherein the comparator identifies the level closest to the partial result.

13. (Currently Amended) The precoder according to claim 12, wherein ~~a~~ the $_\wedge^{the}$ mapper further includes an output block that generates ~~a~~the mapped constellation signal equal to a level inside the basic constellation of levels, if the identified level in the table closest to the partial result is inside the basic constellation of levels.

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14. (Currently Amended) The precoder according to claim 13, wherein the ~~output block includes a summer for adding~~ mapped constellation signal is set equal to the sum of the partial result and a mapping distance signal, wherein the mapping distance signal equals the distance between the index basic_const, <u>associated</u> ~~associate~~ with the basic constellation level of the input signal, and the index positive_const, associated with a level outside the basic constellation <u>of levels</u>.

15. (Original) The precoder according to claim 1, further comprising a digital to analog converter that generates an analog output signal based upon the mapped constellation signal.

16. (Previously Presented) The precoder according to claim 15, further comprising a hybrid for operably coupling the digital to analog converter to an analog subscriber loop.

17. (Currently Amended) The precoder according to claim 1, wherein successive levels in the basic constellation of levels are separated by a distance D1, and wherein a plurality of successive levels outside the basic constellation <u>of levels</u> ~~are~~ <u>is</u> separated by a distance D2 such that D1 differs from D2.

18. (Currently Amended) A precoder for an analog modem, the precoder comprising:

a processing element that generates ~~a~~<u>the</u> mapped constellation signal as a function of a feedback signal and an input signal to the precoder, the processing element including:

an adder that adds together the feedback signal and the input signal to generate a partial result,

a table identifying a basic constellation of levels and levels outside the basic constellation of levels, wherein the levels outside the basic constellation <u>of levels</u> are mapped onto levels

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inside the basic constellation of levels as a function of an index associated with each level in the table,

an output block that generates ~~a~~ ~~the~~ mapped constellation signal equal to a level inside the basic constellation of levels by mapping a partial result outside the basic constellation of levels onto a level inside the basic constellation of levels, and

a feedback filter that generates the feedback signal as a function of the mapped constellation signal output by the processing element.

19. (Currently Amended) The precoder according to claim 18, wherein each of the levels outside the basic constellation of levels in the table ~~are~~is mapped onto only one level inside the basic constellation of levels in the table.

20. (Currently Amended) The precoder according to claim 18, further comprising:

~~a~~the table having a constellation index basic_const, where the basic_const goes from ~~1~~-k to k, associated with each of a plurality of levels inside the basic constellation of levels, and having a constellation index positive_const, where the positive_const goes from k+1 to m, associated with a plurality of levels outside the basic constellation of levels.

21. (Currently Amended) The precoder according to claim 20, wherein each index of the plurality of levels outside the basic constellation of levels ~~index~~ ~~are~~is mapped onto a level inside the basic constellation of levels according to the equation:

index positive_const→positive_const [[_]]- (2*k); while positive_const>m-k; and

index positive_const→positive_const - (2*k)-1; while positive_const<=m-k;

wherein → identifies a ~~the~~ mapping function.

22. (Currently Amended) The precoder according to claim 18, further comprising:

a̶the table having a constellation index basic_const, where the basic_const goes from -1̶k

to [[-]]k, associated with each of a plurality of levels inside the basic constellation of levels, and

having a constellation index negative_const, where the negative _const goes from -k-1 to -m,

associated with a plurality of levels outside the basic constellation of levels.

23. (Currently Amended) The precoder according to claim 22, wherein each of the _index_

plurality of levels outside the basic constellation of levels i̶n̶d̶e̶x̶ a̶r̶eis mapped onto a level inside

the basic constellation of levels according to the equation:

index negative_const→negative_const + (2*k); while negative_const<-(m-k); and

index negative_const→negative_const + (2*k)+1; while negative_const>=-(m-k);

wherein → identifies a t̶h̶e mapping function.

24. (Currently Amended) The precoder according to claim 20, wherein the o̶u̶t̶p̶u̶t̶ ̶b̶l̶o̶c̶k̶

i̶n̶c̶l̶u̶d̶e̶s̶ ̶a̶ ̶s̶u̶m̶m̶e̶r̶ ̶f̶o̶r̶ ̶a̶d̶d̶i̶n̶g̶ mapped constellation signal is set equal to the sum of the partial

result and a mapping distance signal, wherein the mapping distance signal equals the distance

between the index basic_const, associated with the basic constellation level of the input signal,

and the index positive_const, associated with a level outside the basic constellation of levels.

25. (Previously Presented) A method of precoding an input signal to generate a mapped

constellation signal, comprising:

generating a feedback signal from the mapped constellation signal by multiplying a

delayed version of the mapped constellation signal by a weighting element, and

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constellation of levels or whether the partial result is greater than a maximum level of the basic

constellation of levels.

31. (Currently Amended) The method according to claim 30, further including a step of

determining a mapping distance p_j when the partial result is less than the minimum level of the

basic constellation of levels, the mapping distance p_j being equal to a distance between an index

basic_const, associated with thea basic constellation level of the input signal, and an index

positive_const, associated with a level outside the basic constellation of levels, wherein said j

represents said basic constellation level of the input signal and said level outside the basic

constellation of levels.

32. (Currently Amended) The method according to claim 31, wherein the index

positive_const is an index to a level that maps onto the basic constellation level of the input

signal, and wherein the index positive_const is an index to a level in a positive constellation of

levels that includes those levels greater than the maximum level in the basic constellation of levels.

33. (Previously Presented) The method according to claim 32, further including a step of

obtaining the index positive_const from the table.

34. (Currently Amended) The method according to claim 31, further including a step of

generating athe mapped constellation signal by adding together the partial result and the mapping

distance p_j.

35. (Currently Amended) The method according to claim 30, further including a step of

determining a mapping distance n_j, when the partial result is greater than the maximum level of

the basic constellation of levels, the mapping distance n_j being equal to a distance between an

index basic_const, associated with ~~the~~a basic constellation level of the input signal, and an index negative_const, associated with a level outside the basic constellation of levels, wherein j represents said basic constellation level of the input signal and said level outside the basic constellation of levels.

36. (Currently Amended) The method according to claim 35, wherein the index negative_const is an index to a level that maps onto the basic constellation level of the input signal, and wherein the index negative_const is an index to a level in a negative constellation of levels that includes those levels less than the minimum level in the basic constellation of levels.

37. (Original) The method according to claim 36, further including the step of obtaining the index negative_const from ~~a~~ the table.

38. (Currently Amended) The method according to claim 35, further including the step of generating ~~a~~the mapped constellation signal by adding together the partial result and the mapping distance n_j.

39. (Previously Presented) A computer-readable medium having stored thereon a plurality of instructions, the plurality of instructions including instructions that when executed by a processor cause the processor to implement a method of precoding an input signal to generate a mapped constellation signal, the method comprising:

generating a feedback signal from the mapped constellation signal, and

performing an operation on the feedback signal and the input signal based upon an index to a constellation of levels chosen for a precoder, wherein the constellation of levels includes a

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50. (Previously Presented) The apparatus according to claim 49 further including a feedback filter having a delay element and a weighting element such that the feedback filter multiplies a delayed version of the mapped constellation signal by the weighting element to generate the feedback signal.

51. (Currently Amended) The apparatus according to claim 49 further including a feedback filter coupled to said precoder and based upon a model of an impulse response of a communication channel.

52. (Currently Amended) The apparatus according to claim 49 wherein the precoder employs an adder that adds together the feedback signal and the input signal to generate a partial result and a mapper that generates the mapped constellation signal by mapping a partial result outside the basic constellation of levels onto the basic constellation of levels as a function of the index to the constellation of levels, the mapper having a table to identify the basic constellation of levels and associate levels outside the basic constellation of levels to levels inside the basic constellation of levels.

53. (Currently Amended) The apparatus according to claim 49 wherein each of the levels outside the basic constellation of levels areis only associated with one level inside the basic constellation of levels.

54. (Currently Amended) The apparatus according to claim 4̶9̶ 52 f̶u̶r̶t̶h̶e̶r̶ ̶c̶o̶m̶p̶r̶i̶s̶i̶n̶g̶ wherein the precoder includes a table that identifies the basic constellation of levels, wherein the table has a constellation index basic_const, where the basic_const goes from 1̶k to k, associated with each of a plurality of levels inside the basic constellation of levels, and wherein the

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~~precoder~~table has a constellation index positive_const, where the positive_const goes from k+1

to m, associated with a plurality of levels outside the basic constellation of levels, wherein said k

is a constant and said m is a multiple of said k.

55. (Currently Amended) The apparatus according to claim 54 wherein the precoder

maps each of the plurality of levels outside the basic constellation of levels ~~index~~ onto a level

inside the basic constellation of levels according to the equation:

index positive_const→positive_const[[-]] − (2*k); while positive _const>m-k; and

index positive_const→positive_const[[-]] − (2*k)-1; while positive _const<=m-k;

wherein→identifies a ~~the~~ mapping function.

56. (Currently Amended) The apparatus according to claim 49 ~~further comprising a~~

wherein   includes a table
~~table~~the precoder that identifies the basic constellation of levels, wherein the table has a
   ∧   ∧

constellation index basic_const, where the basic_const goes from −k to k [[-1 to −k]], associated

with each of a plurality of levels inside the basic constellation of levels, and wherein the

~~precoder~~table has a constellation index negative_const, where the negative_const goes from -k-1

to -m, associated with a plurality of levels outside the basic constellation of levels, wherein said k

is a constant and said m is a multiple of said k.

57. (Currently Amended) The apparatus according to claim 56 wherein the precoder

maps each of the plurality of levels outside the basic constellation of levels ~~index~~ onto a level

inside the basic constellation of levels according to the equation:

index negative_const→negative_const + (2*k); while negative_const<-(m-k); and

index negative_const→negative_const + (2*k)+1; while negative_const>=-(m-k);

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wherein → identifies <u>a</u> the mapping function.

58. (Previously Presented) The apparatus according to claim 52 wherein the mapper further comprises a comparator for comparing the partial result with the levels in the table.

59. (Previously Presented) The apparatus according to claim 58 wherein the comparator identifies the level closest to the partial result.

60. (Currently Amended) The apparatus according to claim 59 wherein the mapper further includes an output block that generates a<u>the</u> mapped constellation signal equal to a level inside the basic constellation <u>of levels,</u> if the identified level in the table closest to the partial result is inside the basic constellation <u>of levels</u>.

61. (Currently Amended) The apparatus according to claim 6̶0̶ 54, wherein the ~~output block~~ ~~includes a summer for adding~~ <u>mapped constellation signal is set equal to the sum of</u> the partial result and a mapping distance signal, wherein the mapping distance signal equals the distance between the index basic_const, associated with t̶h̶e̶<u>a</u> basic constellation level of the input signal, and the index positive_const, associated with a level outside the basic constellation <u>of levels</u>.

62. (Canceled)

63. (Currently Amended) The apparatus according to claim 49 wherein a plurality of index values a̶r̶e̶<u>is</u> associated, respectively, with a plurality of amplitude levels in the constellation of levels.

64. (Currently Amended) The precoder according to claim 1 wherein a plurality of index values a̶r̶e̶<u>is</u> associated, respectively, with a plurality of amplitude levels in the constellation of levels.

Canceled

65. (Currently Amended) ~~The precoder according to claim 18 wherein a plurality of index values are~~is~~ associated, respectively, with a plurality of amplitude levels in a~~the~~ constellation of levels.~~

66. (Currently Amended) The method of precoding according to claim 25 wherein a plurality of index values ~~are~~is associated, respectively, with a plurality of amplitude levels in the constellation of levels.

67. (Currently Amended) The computer-readable medium of claim 39 wherein a plurality of index values ~~are~~is associated, respectively, with a plurality of amplitude levels in the constellation of levels.

68. (Previously Presented) A precoder for generating a mapped constellation signal, from an input signal, comprising:

a feedback filter, including a delay element and a weighting element, that generates a feedback signal as a function of the mapped constellation signal by multiplying a delayed version of the mapped constellation signal by the weighting element, and

a processing element that generates the mapped constellation signal from the input signal and the feedback signal, the processing element utilizing an index to a constellation of levels chosen for the precoder, wherein the constellation of levels includes a basic constellation of levels and a set of levels outside the basic constellation of levels, such that the amplitude of the mapped constellation signal is limited.

69. (Previously Presented) The precoder according to claim 68, wherein the processing element comprises:

an adder that adds together the feedback signal and the input signal to generate a partial

result, and

a mapper that generates the mapped constellation signal by mapping a partial result

outside the basic constellation of levels onto the basic constellation of levels as a function of the

index to the constellation of levels for the precoder.

70. (Currently Amended) The precoder according to claim 69, wherein the mapper

~~further~~ comprises:

a table identifying the basic constellation of levels and a mapping from the set of levels

outside the basic constellation of levels to levels inside the basic constellation of levels.

71. (Currently Amended) The precoder according to claim 68, wherein each of the levels

outside the basic constellation of levels is mapped onto only one level inside the basic

constellation of levels.

72. (Currently Amended) The precoder according to claim 69, wherein the mapper

comprises:

a table having a constellation index basic_const, where the basic_const goes from ~~1~~-k to

k, associated with each of a plurality of levels inside the basic constellation of levels, and having

a constellation index positive_const, where the positive_const goes from k+1 to m, associated

with a plurality of levels outside the basic constellation of levels.

73. (Currently Amended) The precoder according to claim 69, wherein the mapper

comprises:

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a table having a constellation index basic_const, where the basic_const goes from -1k to

[[-]]k basic_const goes from -1 to -k, associated with each of a plurality of levels inside the basic

constellation of levels, and having a constellation index negative_const, where the

negative_const goes from -k-1 to -m, associated with a plurality of levels outside the basic

constellation of levels.

74. (Previously Presented) The precoder according to claim 72, wherein the mapper

further comprises a comparator for comparing the partial result with the levels in the table.

75. (Previously Presented) The precoder according to claim 74, wherein the comparator

identifies the level closest to the partial result.

76. (Currently Amended) The precoder according to claim 75, wherein the mapper

further includes an output block that generates athe mapped constellation signal equal to a level

inside the basic constellation of levels, if the identified level in the table closest to the partial

result is inside the basic constellation of levels.

77. (Previously Presented) The precoder according to claim 68, further comprising a

digital to analog converter that generates an analog output signal based upon the mapped

constellation signal.

78. (Previously Presented) The precoder according to claim 77, further comprising a

hybrid for operably coupling the digital to analog converter to an analog subscriber loop.

79. (Currently Amended) The precoder according to claim 68 wherein a plurality of

index values areis associated, respectively, with a plurality of amplitude levels in the

constellation of levels.

a table identifying the basic constellation of levels and a mapping from the set of levels outside the basic constellation of levels to levels inside the basic constellation of levels.

83. (Currently Amended) The precoder according to claim 80, wherein each of the levels outside the basic constellation of levels is mapped onto only one level inside the basic constellation of levels.

84. (Currently Amended) The precoder according to claim 81, wherein the mapper comprises:

a table having a constellation index basic_const, where the basic_const goes from $\overline{1}$-k to k, associated with each of a plurality of levels inside the basic constellation of levels, and having a constellation index positive_const, where the positive_const goes from k+1 to m, associated with a plurality of levels outside the basic constellation of levels.

85. (Currently Amended) The precoder according to claim 81, wherein the mapper comprises:

a table having a constellation index basic_const, where the basic_const goes from $\overline{1}$-k to [[-]]k basic_const goes from 1 to k, associated with each of a plurality of levels inside the basic constellation of levels, and having a constellation index negative_const, where the negative_const goes from -k-1 to -m, associated with a plurality of levels outside the basic constellation of levels.

86. (Previously Presented) The precoder according to claim 84, wherein the mapper further comprises a comparator for comparing the partial result with the levels in the table.

91. (Currently Amended) The apparatus according to claim 90 wherein each of the levels outside the basic constellation of levels areis only associated with one level inside the basic constellation of levels.

92. (Currently Amended) The apparatus according to claim 90 further comprising a tablethe precoder that identifies the basic constellation of levels, wherein the table has a constellation index basic_const, where the basic_const goes from -k to k [[-1 to -k]], associated with each of a plurality of levels inside the basic constellation of levels, and wherein the precodertable has a constellation index negative_const, where the negative_const goes from -k-1 to -m, associated with a plurality of levels outside the basic constellation of levels.

93. (Currently Amended) The apparatus according to claim 92 wherein a the mapper maps each of the plurality of levels outside the basic constellation of levels index onto a level inside the basic constellation of levels according to the equation:

index negative_const→negative_const + (2*k); while negative_const<-(m-k); and

index negative_const→negative_const + (2*k)+1; while negative_const>=-(m-k);

wherein→ identifies a the mapping function.

94. (Currently Amended) The apparatus according to claim 90 wherein successive levels in the basic constellation of levels are separated by a distance D1, and wherein a plurality of successive levels outside the basic constellation of levels are is separated by a distance D2 such that D1 differs from D2.

95. (Currently Amended) The apparatus according to claim 90 wherein a plurality of index values ~~are~~is associated, respectively, with a plurality of amplitude levels in the constellation of levels.

96. (Currently Amended) An apparatus for generating a mapped constellation signal from an input signal, comprising:

a feedback filter based upon a model of an impulse response of a communication channel that generates a feedback signal, and

a precoder configured to generate[[_]] the mapped constellation signal from the input signal and the feedback signal, wherein the precoder utilizes a constellation of levels that include a basic constellation of levels and a set of levels outside the basic constellation of levels, and wherein the precoder is configured to associate an index with each of the levels in the constellation of levels such that the levels outside the basic constellation of levels are associated with the levels inside the basic constellation of levels.

97. (Currently Amended) The apparatus according to claim 96 wherein each of the levels outside the basic constellation of levels ~~are~~is only associated with one level inside the basic constellation of levels.

98. (Currently Amended) The apparatus according to claim 96 ~~further comprising~~ a _wherein_ ~~table~~the precoder _includes a table_ that identifies the basic constellation of levels, wherein the table has a constellation index basic_const, where the basic_const goes from $-k$ to k [[-1 to $-k$]], associated with each of a plurality of levels inside the basic constellation of levels, and wherein the

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109. (Currently Amended) The apparatus according to claim 106 ~~further comprising~~ ~~a~~wherein the table that identifies the basic constellation of levels, wherein the table has ~~a~~the constellation index basic_const, where the basic_const goes from –k to k [[-1 to -k]], associated with each of ~~a~~the plurality of levels inside the basic constellation of levels, and wherein the ~~precoder~~table has a constellation index negative_const, where the negative_const goes from -k-1 to -m, associated with a plurality of levels outside the basic constellation of levels.

110. (Currently Amended) The apparatus according to claim 109 wherein ~~a~~ the precoder ~~the mapper~~ maps each of the plurality of levels outside the basic constellation of levels ~~index~~ onto a level inside the basic constellation of levels according to the equation:

index negative_const→negative_const + (2*k); while negative_const<-(m-k); and

index negative_const→negative_const + (2*k)+1; while negative_const>=-(m-k);

wherein→ identifies a ~~the~~ mapping function.

111. (Currently Amended) The apparatus according to claim 109 wherein ~~a~~ the precoder ~~the mapper~~ further comprises a comparator for comparing a partial result with the levels in the table.

112. (Previously Presented) The apparatus according to claim 111 wherein the comparator identifies the level closest to the partial result.

113. (Currently Amended) The apparatus according to claim 112 wherein the precoder ~~mapper~~ further includes an output block that generates ~~a~~ the mapped constellation signal equal to a level inside the basic constellation of levels, if the identified level in the table closest to the partial result is inside the basic constellation of levels.